Fan Efficiency Analysis Tool (FEAT)

Fan Identification

Fan Description	
Fan Location	

Data Collected

Fan Pressure Data

Inlet Dynamic Pressure	(p_{vi})		in.-H_2O	**(N. 1)**
Outlet Dynamic Pressure	(p_{vo})		in.-H_2O	**(N. 1)**
Static Differential Pressure	(Δp_s)		in.-H_2O	**(N. 1)**

Ducting Data

Inlet Duct Inside Diameter	(d_i)		inches	**(N. 2)**
Outlet Duct Inside Diameter	(d_o)		inches	**(N. 2)**

Environmental Data

Barometric Pressure	(p_b)		in.-Hg	**(Rf. 1)**
Absolute Temperature	(T_a)		^oR	**(Rf. 1)**

Input Power Data

Input Power to Fan Drive Shaft	(W_i)		bhp	**(Rf. 2)**

Fluid Properties

Air Density	(ρ)	-	lb./ft.^{3}	**(Eq. 1)**
Gas Compressibility Factor	(K_p)	*0.98*		**(Rf. 3)**

Fan Specifications

Inlet

Inlet Gas Velocity	(V_i)	-	fpm	**(Eq. 2)**
Inlet Duct Cross Sectional Area	(A_i)	-	ft^2	**(Eq. 3)**
Inlet Volumetric Flow Rate	(Q_i)	-	cfm	**(Eq. 4)**

Outlet

Outlet Gas Velocity	(V_o)	-	fpm	**(Eq. 2)**
Outlet Duct Cross Sectional Area	(A_o)	-	ft^2	**(Eq. 3)**
Outlet Volumetric Flow Rate	(Q_o)	-	cfm	**(Eq. 4)**

Fan Performance

Average Volumetric Flow Rate	(Q_{avg})	-	cfm	**(Eq. 5)**
Power Output of Fan	(W_o)	-	hp	**(Eq. 6)**
Mechanical Efficiency of Fan	(η_f)	-		**(Eq. 7)**

Equations

Eq. 1) Air Density (ρ)

$$1.325 \times \left(\frac{p_b}{T_a} \right)$$

Eq. 2) Gas Velocity ($V_{(i,o)}$)

$$1,096.2 \times \sqrt{\frac{p_{v(i,o)}}{\rho}}$$

Eq. 3) Duct Cross Sectional Area ($A_{(i,o)}$)

$$\frac{\pi \times d_{(i,o)}^{\ 2}}{4} \times \frac{1\,ft^2}{144 in^2}$$

Eq. 4) Volumetric Flow Rate ($Q_{(i,o)}$)

$$V_{(i,o)} \times A_{(i,o)}$$

Eq. 5) Avg. Volumetric Flow Rate (Q_{avg})

$$\frac{Q_i + Q_o}{2}$$

Eq. 6) Power Output of Fan (W_o)

$$\frac{Q_{avg} \times \Delta p_s \times K_p}{6,362} \times \frac{0.746 kW}{1 hp}$$

Eq. 7) Mechanical Efficiency of Fan (η_f)

$$\frac{W_o}{W_i}$$

References

Rf. 1) Environmental data is based on local weather station readings, collected from *www.wunderground.com*

Rf. 2) Input power to fan drive shaft is calculated using the Motor Analysis Tool (MAT) on the previous page.

Rf. 3) Gas compressibility factor is estimated based on the static pressure differential using Table 3.1 of the DOE EERE Fan System Assessment Training Manual, 3rd Edition.

Notes

N. 1) A digital manometer was used to collect various pressure measurements.

N. 2) A tape measure was used to determine the size of various fan components.